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Feldspar, Nepheline Syenite, and Aplite

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This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

Feldspar, Nepheline Syenite, and Aplite

By Michael J. Potter[1]

Total U.S. feldspar output in 1985, including soda, potash, or mixed feldspar, and feldspar-silica mixtures, was 700,000 short tons with a value of $22.8 million. Housing and commercial construction activity remained relatively high resulting in continued strong demand for plumbing fixtures, tile, and glass fiber insulation in which feldspar is used. Imports of crude and ground nepheline syenite decreased 12% to about 333,000 tons with a total value of $11.4 million.

Domestic Data Coverage.—Domestic production data for feldspar are developed by the Bureau of Mines by means of a voluntary survey. Of the 15 active mines, 12, or 80%, responded, representing an estimated 81% of the total production data for feldspar shown in table 1. The remaining 19% was estimated from prior years' data adjusted to current industry levels.

Legislation and Government Programs.—According to provisions of the Tax Reform Act of 1969, which continued in force throughout 1985, the depletion rate allowed on domestic and foreign feldspar production was 14%.

Table 1.—Salient feldspar and nepheline syenite statistics

		1981	1982	1983	1984	1985
United States:						
Feldspar:						
Produced[1]	short tons	665,000	615,000	710,000	710,000	700,000
Value	thousands	$21,000	$20,200	$22,500	$23,500	$22,800
Exports	short tons	14,025	10,600	9,300	10,000	9,200
Value	thousands	$1,110	$900	$856	$920	$680
Imports for consumption	short tons	206	48	84	25	952
Value	thousands	$61	$24	$31	$15	$1,150
Nepheline syenite:						
Imports for consumption	short tons	506,100	455,596	407,251	377,945	332,604
Value	thousands	$11,529	$10,701	$10,997	$14,218	$11,435
Consumption, apparent[2] (feldspar plus nepheline syenite)	thousand short tons	1,157	1,060	1,108	1,078	1,024
World: Production (feldspar)	do	r3,561	r3,855	4,000	p4,167	e4,294

eEstimated. pPreliminary. rRevised.

[1]Includes hand-cobbed feldspar, flotation concentrate feldspar, and feldspar in feldspar-silica mixtures; includes potash feldspar (8% K_2O or higher).

[2]Production plus imports minus exports.

FELDSPAR

DOMESTIC PRODUCTION

Soda feldspar is defined commercially as containing 7% soda (Na_2O) or higher; potash feldspar contains 10% potash (K_2O) or higher. However, to publish information on potash feldspar without revealing company proprietary data in this report, feldspars containing 8% K_2O or more are defined as potash feldspars. Hand-cobbed or hand-sorted feldspar is usually obtained from pegmatites and is relatively high in K_2O

compared with Na_2O. Hand cobbing continued to be a minor fraction of total production. Feldspar flotation concentrates, most of the U.S. output, are classified as either soda, potash, or mixed feldspar, depending on the relative amounts of Na_2O and K_2O present. Feldspar-silica mixtures, feldspathic sand, can either be naturally occurring or a flotation product. Total feldspar content of this mixture was 28% of total feldspar output during 1985.

Feldspar was mined in six States, led by North Carolina and followed in descending order by Connecticut, Georgia, California, Oklahoma, and South Dakota. North Carolina accounted for 70% of the total. Eleven U.S. companies operating 15 mines and 13 plants produced feldspar or feldspar-silica mixtures for shipment to more than 31 States and foreign countries, primarily Canada and Mexico. Of the 11 companies, 3 produced potash feldspar, and the remainder produced mixed feldspar or feldspathic sand mixtures. North Carolina had five plants, California had three, and Connecticut, Georgia, South Carolina, and South Dakota each had one.

The data for potash feldspar were collected from the three U.S. producers of this material; some of this feldspar contained less than 10% K_2O (8% to 10% K_2O).

Lithium Corp. of America (Lithco), a wholly owned subsidiary of Gulf Resources & Chemical Corp., was sold to FMC Corp.[2] Lithco's domestic facilities are located near Bessemer City, NC. Ore from the company's open pit mine was milled to produce lithium-bearing spodumene concentrates, by-product mica, and feldspar-silica mixtures.

Table 2.—Feldspar[1] produced in the United States

(Thousand short tons and thousand dollars)

Year	Hand-cobbed		Flotation concentrate		Feldspar-silica mixtures[2]		Total[3]	
	Quantity	Value	Quantity	Value	Quantity	Value	Quantity	Value
1981	11	194	504	16,850	149	4,000	665	21,000
1982	10	172	457	16,090	147	4,040	615	20,300
1983	7	107	525	17,128	178	5,265	710	22,500
1984	7	124	502	17,874	201	5,503	710	23,500
1985	14	W	487	16,781	197	W	700	22,800

W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Includes potash feldspar (8% K_2O or higher).
[2]Feldspar content.
[3]Data may not add to totals shown because of independent rounding.

Table 3.—Producers of feldspar in 1985

Company	Plant location	Product
Arkhola Sand & Gravel Co	Muskogee, OK	Feldspar-silica mixture.
California Silica Products Co	San Juan Capistrano, CA	Do.
Calspar Inc	Santa Fe Springs, CA	Soda feldspar.
Crystal Silica Co	Oceanside, CA	Feldspar-silica mixture.
The Feldspar Corp	Middletown, CT	Soda feldspar.
Do	Monticello, GA	Potash feldspar.
Do	Spruce Pine, NC	Soda feldspar.
Do	Montpelier, VA	Aplite.
Foote Mineral Co	Kings Mountain, NC	Feldspar-silica mixture.
Indusmin Inc	Spruce Pine, NC	Soda feldspar.
International Minerals & Chemical Corp	do	Do.
Kings Mountain Mica Co. Inc	Kings Mountain, NC	Potash feldspar.
Lithium Corp. of America	Bessemer City, NC	Feldspar-silica mixture.
Pacer Corp	Custer, SD	Potash feldspar.
Spartan Minerals Corp	Pacolet, SC	Feldspar-silica mixture.

CONSUMPTION AND USES

The majority of users acquired their supplies already ground and sized by feldspar producers, although some manufacturers of pottery, soaps, and enamels continued to purchase feldspar for grinding to their preferred specifications in their own mills. A substantial portion of the material classified as feldspar-silica mixtures served in glassmaking without additional processing.

Of the total feldspar consumed in the United States, 55% was used in glassmaking, including container glass and glass fiber; 45% was used in pottery; and less than 1% was used in enamels, electrical insulators, etc.

The use of feldspar in pottery articles such as plumbing fixtures and tile increased by 9% compared with that of 1984. This was apparently because of the continued good demand for plumbing fixtures and tile in the housing market.

Table 4.—Destination of shipments of feldspar[1] sold or used by producers in the United States, by State

(Short tons)

State	1981	1982	1983	1984	1985
Alabama	19,600	16,500	14,600	15,100	W
California[2 3]	35,000	30,000	45,000	45,000	50,000
Connecticut	17,800	18,800	W	W	W
Florida	25,700	21,000	22,700	20,300	16,900
Georgia	68,300	74,600	96,900	96,000	95,300
Illinois	31,100	26,900	46,600	38,000	37,000
Indiana	22,700	20,200	37,200	r35,700	W
Kentucky	11,700	13,400	11,400	13,300	16,200
Louisiana	13,900	12,200	17,400	21,300	12,200
Maryland	4,300	4,600	4,500	7,400	7,400
Massachusetts	8,800	9,300	1,200	r10,800	W
Michigan	W	2,000	W	W	W
Mississippi	13,000	15,800	15,900	12,000	W
Missouri	4,300	4,100	5,000	4,400	4,700
New Jersey	63,400	51,700	56,600	53,200	W
New York	19,400	17,800	18,300	r10,800	W
North Carolina	17,000	16,500	20,100	16,400	17,000
Ohio	52,800	51,600	53,600	r64,900	65,800
Oklahoma	34,700	31,900	W	W	W
Pennsylvania	42,900	28,800	33,200	r37,200	31,100
South Carolina	16,400	14,900	18,400	17,400	W
Tennessee	16,100	15,300	W	W	W
Texas	39,400	36,700	41,900	r41,400	42,000
West Virginia	36,100	31,600	38,100	r28,500	27,000
Wisconsin	W	W	9,400	11,100	W
Other destinations[3]	40,600	43,800	102,000	r99,800	277,400
Total	655,000	610,000	710,000	r700,000	700,000

eEstimated. rRevised. W Withheld to avoid disclosing company proprietary data; included with "Other destinations."

[1]Includes potash feldspar (8% K_2O or higher).

[2]Data are incomplete, and estimates are very rough.

[3]Includes Arkansas, Colorado, Kansas, Minnesota, Rhode Island, Virginia, States indicated by symbol W, and unspecified States. Also includes exports to Canada, Mexico, and other foreign countries.

Table 5.—Destination of shipments of potash feldspar[1] sold or used by producers in the United States

(Short tons)

Destination	1981	1982	1983	1984[r]	1985
Illinois, Indiana, Wisconsin	11,300	8,000	6,000	5,800	5,800
Maryland, New York, West Virginia	24,800	21,600	25,300	21,800	28,000
Ohio	9,800	8,100	8,100	9,000	8,200
Pennsylvania	9,100	6,400	7,100	13,500	8,200
Texas	200	200	300	200	200
Canada	4,900	3,200	4,300	4,600	5,200
Mexico	2,800	2,400	W	W	W
Other[2]	17,500	16,300	14,100	16,400	21,400
Total	80,400	66,200	65,200	71,300	77,000

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Other."
[1]K_2O content of 8% or higher.
[2]Includes Alabama, Arkansas, California, Colorado, Connecticut, Florida, Georgia, Kansas, Kentucky, Michigan, Massachusetts, Minnesota, Missouri, New Jersey, North Carolina, South Carolina, Tennessee, States indicated by symbol W, and other unspecified States. May also include foreign countries.

Table 6.—Feldspar[1] sold or used by producers in the United States, by use

(Thousand short tons and thousand dollars)

Use	1984		1985	
	Quantity	Value	Quantity	Value
Hand-cobbed:				
Pottery	6	487	12	W
Other	1	51	1	W
Total	7	538	13	W
Flotation concentrate:				
Glass	229	7,063	216	7,207
Pottery	[r]253	[r]12,100	276	14,135
Other	W	W	--	--
Total	W	W	492	21,342
Feldspar-silica mixtures:[3]				
Glass	153	7,468	173	8,351
Pottery	28	1,367	25	W
Other	W	W	--	--
Total	W	W	198	W
Total:[3]				
Glass[4]	382	14,531	389	15,558
Pottery	[r]287	[r]13,954	313	W
Other[5]	[r]28	[r]1,568	1	W
Total	[r]700	[r]30,100	700	32,000

[r]Revised. W Withheld to avoid disclosing company proprietary data; included in "Total."
[1]Includes potash feldspar (8% K_2O or higher).
[2]Feldspar content.
[3]Data may not add to totals shown because of independent rounding.
[4]Includes container glass and glass fiber.
[5]Includes enamel, filler, etc., and unknown.

Table 7.—Potash feldspar[1] sold or used by producers in the United States, by use

Use	1984[r]		1985	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Pottery	52,200	$3,790	59,300	W
Other[2]	19,100	990	17,700	W
Total	71,300	4,780	77,000	W

[r]Revised. W Withheld to avoid disclosing company proprietary data.
[1]K_2O content of 8% or higher.
[2]Includes glass, enamel, etc.

PRICES

Most feldspar prices increased compared with those of 1984. Engineering and Mining Journal, December 1985, listed the following prices for feldspar, per short ton, f.o.b. mine or mill, carload lots, bulk, depending on grade:

	1984	1985
Connecticut:		
20 mesh, granular	$39.00	$41.35
200 mesh	53.25	56.50
Georgia:		
40 mesh, granular	54.00	57.25
200 mesh	73.50	76.50
North Carolina:		
20 mesh, flotation	29.25	29.25
40 mesh, flotation	54.00	57.25
200 mesh, flotation	NA	76.50

NA Not available.

Source: Engineering and Mining Journal, v. 186, No. 12, Dec. 1985, p. 11.

FOREIGN TRADE

U.S. exports classified as feldspar, leucite, and nepheline syenite, but presumably mostly feldspar, decreased 8% to 9,280 tons valued at $680,000. Chief recipients were Canada, 51%; the Dominican Republic, 18%; Mexico, 11%; and Taiwan, 6%. The remaining 14% was shared among eight other countries.

In addition to feldspar and nepheline syenite, the United States imported 580 tons of "Other mineral fluxes, crushed" with a value of $323,000. This represented a 59% decrease in tonnage compared with that of 1984. Also, 60,400 tons of "Other crude natural mineral fluxes" was imported with a value of about $3.0 million. This was a 39% decrease in tonnage compared with that of 1984.

The tariff schedule in force throughout 1985 for most favored nations provided for a 3.0% ad valorem duty on ground feldspar; imports of unground feldspar were admitted duty free.

Table 8.—U.S. exports of feldspar, by country

Country	1984		1985	
	Short tons	Value	Short tons	Value
Canada	6,040	$378,100	4,700	$290,100
Dominican Republic	1,020	107,400	1,640	100,300
Mexico	1,180	179,400	1,000	54,800
Philippines	270	27,100	--	--
Taiwan	600	112,000	560	100,400
Venezuela	400	38,300	270	60,000
Other	480	77,400	1,110	74,100
Total	10,080	919,700	9,280	679,700

Source: Bureau of the Census.

Table 9.—U.S. imports for consumption of feldspar, by type and country

Type and country	1984		1985	
	Short tons	Value	Short tons	Value
Crude:				
Canada	--	--	20	$9,000
Germany, Federal Republic of	1	$361	--	--
Mexico	--	--	214	19,328
United Kingdom	1	561	--	--
Venezuela	--	--	702	1,097,600
Ground, crushed, or pulverized:				
France	11	9,800	--	--
Germany, Federal Republic of	2	227	--	--
Netherlands	--	--	9	19,116
Switzerland	--	--	1	2,428
United Kingdom	10	3,595	6	2,991
Total	25	14,544	952	1,150,463

Source: Bureau of the Census.

WORLD REVIEW

Germany, Federal Republic of.—Although a major producer of feldspar, the country relied on imports of feldspar and nepheline syenite from the Scandinavian countries. The majority of feldspar was used as a flux in the ceramics industry, of which the Federal Republic of Germany was a leading producer. The most important feldspar producing region contained feldspar-quartz-pegmatites and their derived pegmatite sands, which were mined and beneficiated in conjunction with kaolin and silica sand. Amberger Kaolinwerke GmbH was Western Europe's largest producer of potassium feldspar with about 130,000 tons per year. Gebruder Dorfner OHG had an output of about 28,000 tons per year of feldspar. The ceramic manufacturer Hutschenreuther AG also worked pegmatite sands and had an annual capacity of 44,000 tons of feldspar. Saarfeldspatwerke H. Huppert GmbH & Co. KG of Saarbrucken was mining 55,000 to 66,000 tons per year of feldspar. The country's largest tile manufacturer and major whiteware ceramic producer, Villeroy and Boch Keramisch Werke KG, worked partly kaolinized, feldspar-rich rhyolites and was producing about 55,000 tons per year of feldspar for its own consumption. Rhyolites are fine-grained igneous rocks having a chemical composition similar to that of granite. A final source of feldspathic material was phonolite, which is an igneous rock containing feldspar. The major producer of phonolite was the Brenk Mine at Eifel, operated by Kali Chemie AG. Annual production was approximately 140,000 tons, which was primarily for the manufacture of colored glass.[3]

Greece.—The Hellenic Industrial Development Bank reportedly began work on its feldspar mine at Paranesti near Drama. In the first stage, production was planned at a rate of 31,000 tons per year at an estimated cost of $2.7 million. Upon completion of the facility, annual output was projected to rise to 86,000 tons. Greece imported up to 15,000 tons per year of feldspar during the previous decade.[4]

The final stage of construction for a plant owned by Dr. Georgiadis to process quartz and feldspar, and potentially other minerals, continued in 1985 at Assiros in northern Greece, approximately 15 miles north of Thessalonike. The feldspar was a soda feldspar occurring in pegmatite veins. Processing steps would be employed to remove mica and iron oxide. Quartz and feldspar would be sold for use in ceramics and paint. Feldspar sales would be directed at eastern and central Mediterranean countries and the Middle East, after satisfying local demand.[5]

Spain.—Industrias del Cuarzo S.A. continued mining operations at a large feldspathic sand deposit at Carrascal del Rio in Segovia Province. The processing plant produced silica, feldspathic sand, and feldspar.

Llansa S.A. worked five quarries near Llansa in Gerona Province. The deposit was in the form of pegmatite veins, with three of the quarries containing soda feldspar and two containing mixed soda-potash feldspar. Proven reserves were in excess of 5 million tons. Processing steps included crushing, washing to separate clays, and air separation. Plant capacity was 44,000 tons per year. A second milling plant, which would include magnetic separation and air separators of a new design and would double capacity to 88,000 tons per year, was targeted to come on-stream at yearend 1985.[6]

United Kingdom.—Feldspar imports in 1984 were 60,000 tons. Principal countries of origin and the share supplied were Finland, 43%; Norway, 26%; and Sweden, 20%.[7]

Table 10.—Feldspar: World production, by country[1]

(Thousand short tons)

Country[2]	1981	1982	1983	1984[p]	1985[e]
Argentina	29	17	22	e22	22
Australia	4	5	4	e4	4
Austria	11	3	1	3	3
Brazil[3]	131	145	136	116	132
Burma	5	3	3	7	7
Chile	3	1	3	3	3
Colombia	30	33	35	36	35
Egypt	4	9	7	e6	6
Finland	70	77	57	62	61
France	211	191	193	230	231
Germany, Federal Republic of	377	365	364	r e287	309
Guatemala[e]	4	13	7	r6	6
Hong Kong	65	36	62	127	83
India	2	49	46	44	44
Iran[e]	472	3	3	3	3
Italy	28	864	951	1,086	4,1,231
Japan[5]	(6)	33	34	39	34
Kenya	114	—	1	1	1
Korea, Republic of	144	94	121	140	110
Mexico	2	127	130	93	110
Morocco	1	1	1	e1	1
Mozambique	6	1	1	e1	1
Nigeria[e]	r64	6	6	6	6
Norway[7]	12	r69	64	r e66	66
Pakistan	4,24	r9	6	6	6
Peru[e]	18	28	28	28	28
Philippines	90	17	7	13	13
Poland[e]	4,49	88	88	88	88
Portugal[e]	r93	47	46	44	39
Romania[e]	63	r93	r94	r94	95
South Africa, Republic of	143	53	50	43	35
Spain[8]	e4	144	128	e127	132
Sri Lanka	44	3	3	6	6
Sweden	19	60	58	e61	61
Taiwan	27	12	13	17	17
Thailand	77	21	53	82	83
Turkey[e]	350	77	4,10	11	22
U.S.S.R.[e]	r6	360	360	360	370
United Kingdom (china stone)	665	r6	7	7	7
United States	3	615	710	710	4,700
Uruguay	24	1	1	e1	1
Venezuela	59	e8	41	r e32	31
Yugoslavia	(6)	47	46	e46	50
Zambia	3	(6)	(6)	(6)	(6)
Zimbabwe		1	2	2	1
Total	r3,561	r3,835	4,003	4,167	4,294

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through May 6, 1986.

[2]In addition to the countries listed, Czechoslovakia, Madagascar, and Namibia produce feldspar, but output is not officially reported, and available general information is inadequate for the formulation of reliable estimates of output levels.

[3]Series excludes production of leucite and sodalite; data consist only of that material reported by Brazil under the heading of "Feldspar." Data represent the sum of (1) run-of-mine production for direct sale and (2) salable beneficiated product; total run-of-mine feldspar production was as follows, in thousand short tons: 1981—121 (revised); 1982—87; 1983—71 (revised); 1984—93; and 1985—100 (estimated).

[4]Reported figure.

[5]In addition, the following quantities of aplite were produced, in thousand short tons: 1981—386; 1982—385; 1983—442 (revised); 1984—486; and 1985—515 (estimated).

[6]Less than 1/2 unit.

[7]Excludes nepheline syenite.

[8]Includes pegmatite.

NEPHELINE SYENITE

Nepheline syenite is a quartz-free, light-colored rock that, although resembling medium-grained granite in texture, consists principally of nepheline and alkali feldspars, usually in association with minor amounts of other minerals. Large quantities of nepheline syenite, after processing to remove contaminants, especially iron-bearing minerals, were consumed in making glass and ceramics. There was no domestic production of nepheline syenite in grades suitable for these purposes, and U.S. needs were wholly supplied by imports.

With the purchase of IMC Industry

Group (Canada) Ltd. in 1985, Falconbridge Ltd. became owner of both nepheline syenite operations in Canada. The two operations, IMC and Indusmin Ltd., a division of Falconbridge, were mined at different points on the Nephton nepheline syenite deposit in the Blue Mountain District of Ontario, Canada.[8]

In Norway, nepheline syenite was produced at the Norsk Nefelin underground mining operation on the Arctic island of Stjernoy. Sales were mostly to markets in Western Europe.

About two-thirds of the output from Canada and Norway was consumed in insulation fiberglass and container glass manufacture. The second largest outlet was in ceramics, especially porcelain, tile, and whitewares. Nepheline syenite also was used in fine-grind applications as an extender in paint and an inert filler in plastics.[9]

In the U.S.S.R., development of the mineral resource known as synnyrite was being considered. The mineral, which has been identified in only two locations in Siberia, is similar to nepheline syenite and is made up essentially of the potassium analog of nepheline-kalsilite, $K_2O \cdot Al_2O_3 \cdot 2SiO_2$; and potassium feldspar, $K_2O \cdot Al_2O_3 \cdot 6SiO_2$. Synnyrite is a potential raw material for the production of alumina for reduction to aluminum and nonchlorine-containing potassium fertilizers. The typical composition of synnyrite is SiO_2, 54%; Al_2O_3, 22%; and K_2O, 19%. Various technologies for processing the mineral were being tested, including one that uses sulfuric acid to decompose the synnyrite into alum, $KAl(SO_4)_2$, and silica, SiO_2.[10]

The price for Canadian nepheline syenite, glass grade, bulk, 30 mesh, carlots or trucklots, was $20 to $28 per ton, depending on iron content, according to Industrial Minerals (London), December 1985.

Table 11.—U.S. imports for consumption of nepheline syenite

Year	Crude		Ground	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1983	212	$13	407,139	$13,984
1984	410	17	377,535	14,201
1985	920	62	331,684	11,373

Source: Bureau of the Census.

APLITE

Aplite is a feldspar mineral that has more than one geological definition. However, aplite from the only active U.S. operation contains primarily lime-soda feldspar. Aplite, usually unsuitable for use in ceramics, has been used in the manufacture of glass, especially container glass, when it is sufficiently low in iron. Japan, with an annual production of approximately 450,000 tons, has been the world's foremost producer of aplite.

Aplite of glassmaking quality was produced in the United States from one surface mine. The Feldspar Corp. mined aplite near Montpelier, Hanover County, VA, and treated the material by wet grinding, classification, and spiraling to remove biotite, ilmenite, and rutile, followed by dewatering and high-intensity magnetic separation to eliminate iron-bearing minerals.

Domestic output of aplite increased over that of 1984. The data are company proprietary and cannot be released for publication. Aplite traditionally has a somewhat lower price than feldspar. Industrial Minerals (London), December 1985, gave a value of $25.75 per ton for glass grade, bulk, 100% plus 200 mesh, f.o.b. Montpelier, VA.

[1]Physical scientist, Division of Industrial Minerals.
[2]Chemical & Engineering News. Gulf Resources To Sell Lithium Unit to FMC. V. 63, No. 22, June 3, 1985, p. 10.
[3]Robbins, J. The Industrial Minerals of West Germany. Ind. Miner. (London), No. 219, Dec. 1985, p. 39.
[4]Mining Journal (London). Paranesti Feldspar for Greece. V. 304, No. 7795, Jan. 11, 1985, p. 26.
[5]Griffiths, J. Hellenic Industrial Minerals. Ind. Miner. (London), No. 208, Jan. 1985, p. 39.
[6]———. Spain's Industrial Minerals. Ind. Miner. (London), No. 217, Oct. 1985, p. 46.
[7]Industrial Minerals (London). United Kingdom Industrial Minerals Statistics. No. 211, Apr. 1985, p. 83.
[8]———. Falconbridge Dominates Nepheline Syenite. No. 214, July 1985, p. 10.
[9]Ash, D. R. Nepheline Syenite. Min. Eng., v. 37, No. 5, May 1985, p. 477.
[10]Soviet Geography. Potential Uses of Synnyrite Being Studied. V. 26, Jan. 1985, p. 64.

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